properties of the thin film ceramic support material on catalytic activity are being assessed.

Keywords: Ceramics, Catalysts

DEVICE OR COMPONENT FABRICATION, BEHAVIOR OR TESTING

489. ***MATERIALS AND COMPONENTS IN FOSSIL ENERGY APPLICATIONS* NEWSLETTER**
$60,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: I. G. Wright, (423) 574-4451

The purpose of this task is to publish a periodic (bimonthly) DOE-EPRI newsletter to address current developments in materials and components in fossil energy applications. Equal funding is provided by EPRI.

Keywords: Materials, Components

490. **CERAMIC FIBER FILTER TECHNOLOGY**
$50,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: M. A. Janney, (614) 424-4281

The purpose of this effort is to develop the fabrication technology necessary to make ceramic-fiber based filters for a variety of filtration applications of interest to the Fossil Energy community.

Keywords: Filters, Ceramics, Fibers

491. **FABRICATION OF FULL-SCALE FIBER-REINFORCED HOT-GAS FILTERS BY CHEMICAL VAPOR DEPOSITION**
$0 (PYF)*
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
3M Company Contact: M. A. Leitheiser, (612) 733-9394

The purpose of this project is to scale-up the chemical vapor infiltration and deposition (CVID) process developed at Oak Ridge National Laboratory for fabricating ceramic fiber-ceramic matrix composites. The goal is to use the scaled-up CVID process to produce composite filters that have the requisite strength and toughness, but which also have sufficient porosity to be permeable to gas streams and the appropriate size and distribution of porosity to be an effective filter. A practical process for fabricating porous ceramic fiber-ceramic matrix candle filters (full-size) with increased surface area has been developed.

Keywords: Ceramics, Composites, Filters

492. **DEVELOPMENT OF CERAMIC MEMBRANES FOR GAS SEPARATION**
$400,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Oak Ridge K-25 Site Contact: D. E. Fain, (423) 574-9932

The purpose of this activity is to fabricate inorganic membranes for the separation of gases at high temperatures and/or in hostile environments, typically encountered in fossil energy conversion processes such as coal gasification. This work is performed in conjunction with a separate research activity that is concerned with the development and testing of the ceramic membranes.

Keywords: Ceramics, Membranes, Filters, Separation

493. **CORROSION PROTECTION OF CERAMIC HEAT EXCHANGER TUBES**
$125,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Pennsylvania State University Contact: R. E. Tressler, (814) 865-7961

This project addresses the development of ceramic heat exchanger materials with chromia surface treatments for corrosion resistance. High chromia-content refractories have been demonstrated to be resistant to corrosion by coal slags. This project will focus on improving the corrosion resistance of ceramics by incorporating chromia into the surface layers.

Keywords: Ceramics, Corrosion, Filters

*PYF denotes that funding for this activity, active in FY 1995, was provided from prior year funds.

494. **INVESTIGATION OF THE MECHANICAL PROPERTIES AND PERFORMANCE OF CERAMIC COMPOSITE COMPONENTS**
$150,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Virginia Polytechnic Institute Contact: K. L. Reifsnider, (703) 231-5259

The purpose of this project is to develop a test system and test methods to obtain information on the properties and performance of ceramic composite materials. The work involves a comprehensive mechanical characterization of composite engineering components such as tubes, plates, shells, and beams subjected to static and cyclic multiaxial loading at elevated temperatures for extended time periods.

Keywords: Ceramics, Composites, Mechanical Properties, Testing

495. **STABILITY OF SOLID OXIDE FUEL CELL (SOFC) MATERIALS**
$250,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Pacific Northwest Laboratory Contact: L. R. Pederson, (509) 375-2579

The purpose of this task is to evaluate the chemical and physical stability of fuel cell materials and interfaces under conditions relevant to an operating SOFC and to identify features in SOFC operation that would limit system performance.

Keywords: Fuel Cells, SOFC

496. **MIXED OXYGEN ION/ELECTRON-CONDUCTING CERAMICS FOR OXYGEN SEPARATION AND FUEL CELLS**
$225,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Pacific Northwest Laboratory Contact: L. R. Pederson, (509) 375-2579

The purpose of this task is to develop ceramic compositions and physical forms that will provide the highest possible oxygen separation efficiencies from air at the lowest cost.

Keywords: Fuel Cells, Electrochemical, Electrolytes

497. **PROTON-CONDUCTING CERATE CERAMICS**
$225,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Pacific Northwest Laboratory Contact: L. R. Pederson, (509) 375-2579

The purpose of this task is to develop cerate perovskites for use as hydrogen separation membranes, as hydrogen sensors, in membrane reactors, and in gas cleanup.

Keywords: Fuel Cells, Electrochemical, Electrolytes

498. **ODS Fe_3Al TUBES FOR HIGH-TEMPERATURE HEAT EXCHANGERS**
$53,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
PM Hochtemperatur-Metall. GmbH Contact: Dieter Sporer, 011-43-5672-70-2923

The goal of the work is to produce tubes of Fe_3Al-0.5 wt. percent Y_2O_3 which have properties suitable for application as heat transfer surfaces in very high-temperature heat exchangers. The alloy is produced by a powder metallurgical (mechanical alloying) process, the main purpose of which is to obtain a uniform distribution of sub-micron Y_2O_3 particles in the Fe_3Al matrix. The required high-temperature creep strength is derived largely by developing very large, elongated grains which are effectively pinned by the oxide dispersion. Development of the necessary grain structure is dependent on the characteristics of the mechanically-alloyed powder, and on thermomechanical processing of the consolidated powder.

Keywords: Aluminide, Tubes, Heat Exchangers

499. **POROUS IRON ALUMINIDE ALLOYS**
$23,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Oak Ridge K-25 Site Contact: D. E. Fain, (423) 574-9932

This project is directed to the development of porous iron aluminide structures for applications such as hot-gas filters

Keywords: Filters, Aluminides

500. **IRON ALUMINIDE FILTERS**
$50,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: P. F. Tortorelli, (423) 574-5119

The purpose of this project is to provide technical support to the Pall Corporation in its development of porous sintered iron-aluminide filters for hot-particle removal from product streams in coal gasification systems. The ORNL role is to provide specialized expertise in the areas of corrosion analysis, microstructural characterization, alloy selection, and processing based on extensive experience with iron aluminides and materials performance in fossil energy systems. ORNL's contribution via this project should aid the success and timely completion of Pall's development and demonstration efforts.

Keywords: Filters, Aluminides

501. **EVALUATION OF CERAMIC HEAT EXCHANGER TUBES AND JOINTS**
$158,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Pennsylvania State University Contact: R. E. Tressler, (814) 865-7961

This project has two principal parts: (1) screening analysis of candidate ceramic hot-gas filter materials, and (2) development of ceramic heat exchanger materials with chromium surface treatments for corrosion resistance. A flow-through screening test will be developed to test ceramic hot-gas filter elements in simulated coal combustion environments. Corrosion-resistant heat exchanger tubes will be fabricated by incorporating chromium in the surface layers.

Keywords: Ceramics, Corrosion, Filters

502. **THERMAL AND MECHANICAL ANALYSIS OF A CERAMIC TUBESHEET**
$40,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Mallett Technology Contact: R. H. Mallett, (919) 406-1500

A transport combustor is being commissioned at the Southern Services facility in Wilsonville, Alabama, to provide a gaseous product for the assessment of hot-gas filtering systems. These hot-gas filtration systems will include granular-bed and barrier filter concepts. Filters will be evaluated for carbonizer and gasifier gaseous products. In addition, a pressurized fluidized-bed combustor (PFBC) will be installed to burn the carbonizer product, and a hot gas filter will be installed in the PFBC gas stream. Compositions of the gas streams will range from oxidizing to reducing, and the partial pressures of oxygen and sulfur will vary substantially. Temperatures of the gas streams will range from 840 to 980°C (or higher). One of the barrier filters under consideration incorporates a ceramic tubesheet to support the candle filters. This system, to be designed and built by Industrial Filter & Pump Manufacturing Company (IF&PM) is unique and may offer distinct advantages over metal/ceramic systems that have been tested extensively in other EPRI/DOE projects. To gain an insight that could prove to be useful in the scaleup of a commercial-size, all-ceramic system, work will be undertaken to develop a design methodology applicable to the thermal-mechanical analysis of the all-ceramic system.

Keywords: Ceramics, Tubesheet

503. **CERAMIC TUBESHEET DESIGN ANALYSIS**
$10,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: R. W. Swindeman, (423) 574-5108

The purpose of this task is to perform thermal and mechanical analyses of critical regions in a ceramic tubesheet support for barrier filters in a hot gas cleanup vessel designed for use in gasifier, carbonizer, and pressurized fluidized bed combustion gas streams.

Keywords: Ceramics, Tubesheet

INSTRUMENTATION AND FACILITIES

504. **MANAGEMENT OF THE FOSSIL ENERGY AR&TD MATERIALS PROGRAM**
$400,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824

The overall objective of the Fossil Energy Advanced Research and Technology Development (AR&TD) Materials program is to conduct a fundamental, long-range research and development program that addresses, in a generic way, the materials needs of fossil energy systems and ensures the development of advanced materials and processing techniques. The purpose of this task is to manage the Fossil Energy AR&TD Materials program in accordance with procedures described in the Program Management Plan approved by DOE. This task is responsible for preparing the technical program implementation plan for DOE approval; submitting budget proposals for the program; recommending work to be accomplished by subcontractors, other national laboratories, and by Oak Ridge National Laboratory (ORNL); placing and managing subcontracts for fossil energy materials development at industrial research centers, universities, and other government laboratories; and for reporting the progress of the program.

Keywords: Management, Materials Program

505. **GENERAL TECHNOLOGY TRANSFER ACTIVITIES**
$35,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824

The task provides funds for the initiation of technology transfer activities to identify and develop relationships with industrial partners for the transfer of AR&TD Materials Program technologies to industry.

Keywords: Technology Transfer

506. **GORDON RESEARCH CONFERENCE SUPPORT**
$4,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824

The task provides funds to support the annual Gordon Research Conference.

Keywords: Technology Transfer

507. **Mo-Si ALLOY DEVELOPMENT**
$10,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: C. T. Liu, (423) 574-4559

The objective of this task is to develop new-generation corrosion-resistant Mo-Si alloys for use as hot components in advanced fossil energy conversion and power generation systems. The successful development of Mo-Si alloys is expected to improve the thermal efficiency and performance of fossil energy systems through increased operating temperature and to increase the service life of hot components exposed to corrosive environments at high temperatures (to 1600°C). The initial effort is devoted to Mo_5Si_3-base alloys containing boron additions.

Keywords: Alloys, Molybdenum, Silicon

508. **TECHNOLOGY TRANSFER - IRON ALUMINIDES**
$60,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: V. K. Sikka, (423) 574-5112

A Cooperative Research and Development Agreement (CRADA) has been established with ABB Combustion Engineering for the development of corrosion-resistant surface protection for fossil power systems.

Keywords: Alloys, Iron-Aluminum, Corrosion, Technology Transfer

509. **COMMERCIAL-SCALE MELTING AND PROCESSING OF LOW-ALUMINUM CONTENT ALLOYS**
$50,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: V. K. Sikka, (423) 574-5112

The purpose of this activity is the preparation and evaluation of castings of FAPY alloy. The castings will be prepared in several types of molds including: (1) graphite, (2) sand, and (3) investment. Castings will be prepared primarily from the air-induction-melted material. Selected graphite and investment castings will also be prepared from the vacuum- induction-melted material. The graphite and sand castings will be prepared at ORNL and will also be procured from the commercial foundries. The castings will be evaluated for porosity, grain structure, mechanical properties, and weldability. The mechanical property evaluation will consist of Charpy, tensile, and creep testing.

Keywords: Alloys, Iron-Aluminum, Melting, Casting

510. **DEVELOPMENT OF A MODIFIED 310 STAINLESS STEEL**
$120,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: R. W. Swindeman, (423) 574-5108

The purpose of this task is to evaluate structural alloys for improved performance of high-temperature components in advanced combined-cycle and coal-combustion systems.

Keywords: Materials, Mechanical Properties, Austenitics, Hot-Gas

511. **TECHNOLOGY TRANSFER - ADVANCED AUSTENITICS**
$80,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: R. W. Swindeman, (423) 574-5108

A Cooperative Research and Development Agreement (CRADA) has been established with ABB Combustion Engineering for the development of advanced austenitic alloys for fossil power systems.

Keywords: Alloys, Austenitics, Technology Transfer

512. **INFLUENCE OF PROCESSING ON MICROSTRUCTURE AND PROPERTIES OF ALUMINIDES**
$175,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Idaho National Engineering Laboratory Contact: R. N. Wright, (208) 526-6127

The purpose of this project is to determine the influence of processing on the properties of alloys based on Fe_3Al. Thermomechanical processing is pursued to improve their room-temperature ductility. The response of the microstructure to annealing will be characterized in terms of the establishment of equilibrium phases and degrees of long-range order. The mechanical properties are determined at room and elevated temperatures and related to the microstructure.

Keywords: Aluminides, Processing, Microstructure

513. **INVESTIGATION OF ELECTROSPARK DEPOSITED COATINGS FOR PROTECTION OF MATERIALS IN SULFIDIZING ATMOSPHERES**
$75,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Pacific Northwest National Laboratory Contact: R. N. Johnson, (509) 375-6906

The purpose of this task is to examine the use of the electrospark deposition coating process for the application of corrosion-, erosion-, and wear-resistant coatings to candidate heat exchanger (including superheater and reheater) alloys. Materials to be deposited may include MCrAl, MCrAlY, highly wear-resistant carbides, and other hardsurfacing materials.

Keywords: Coatings, Materials, Deposition

514. **TECHNOLOGY TRANSFER - ELECTROSPARK DEPOSITED COATINGS FOR PROTECTION OF MATERIALS IN SULFIDIZING ATMOSPHERES**
$80,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Pacific Northwest National Laboratory Contact: R. N. Johnson, (509) 375-6906

The purpose of this task is to transfer to industry the electrospark deposition coating process technology for the application of corrosion-, erosion-, and wear-resistant coatings to candidate heat exchanger [including superheater and reheater] alloys.

Keywords: Coatings, Materials, Deposition

515. **ENGINEERING-SCALE DEVELOPMENT OF THE VAPOR-LIQUID-SOLID (VLS) PROCESS FOR THE PRODUCTION OF SILICON CARBIDE FIBRILS**
$0 (PYF)*
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
The Carborundum Company Contact: S. K. Lau, (716) 278-2004

The purpose of this work is to transfer to industry a specific technology developed by the DOE AR&TD Materials Program for the production of silicon carbide fibrils for the reinforcement of ceramic matrices. The Vapor-Liquid-Solid (VLS) process was developed at Los Alamos National Laboratory for the growth of silicon carbide fibrils of up to 75 mm in length which can be reduced in length by subsequent processing. The purpose of the work is to develop the VLS process into an engineering-scale process that will enable the U.S. industrial sector to commercialize the process for the production of fibrils for the reinforcement of structural ceramic components.

Keywords: Whiskers, Fibers, Ceramic

*PYF denotes that funding for this activity, active in FY 1995, was provided from prior year funds.

516. **CERAMIC COMPOSITE PROCESSING EQUIPMENT**
$30,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: D. P. Stinton, (423) 574-4556

This task provides funds for the procurement of major equipment items necessary for AR&TD Materials Program activities.

Keywords: Equipment

517. **FABRICATION OF FIBER-REINFORCED COMPOSITES BY CHEMICAL VAPOR INFILTRATION AND DEPOSITION**
$150,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: D. P. Stinton, (423) 574-4556

The purpose of this task is to develop a process for the fabrication of fiber-reinforced ceramic composites having high fracture toughness and high strength. This process utilizes a steep temperature gradient and a pressure gradient to infiltrate low-density fibrous structures with gases, which deposit solid phases to form the matrix of the composite. Further development of this process is needed to fabricate larger components of more complex geometry, and to optimize infiltration for shortest processing time, greatest density and maximum strength.

Keywords: Composites, Fiber-Reinforced, Ceramics

518. **COMPLIANT OXIDE COATING DEVELOPMENT**
$75,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: D. P. Stinton, (423) 574-4556

Monolithic SiC heat exchangers and fiber-reinforced SiC-matrix composite heat exchangers and filters are susceptible to corrosion by alkali metals at elevated temperatures. Protective coatings are currently being developed to isolate the SiC materials from the corrodents. Unfortunately, these coatings typically crack and spall when applied to SiC substrates. The purpose of this task is to determine the feasibility of using a compliant material between the protective coating and the substrate. The low-modulus compliant layer could absorb stresses and eliminate cracking and spalling of the protective coatings.

Keywords: Ceramics, Oxides, Coatings

519. **DEVELOPMENT OF OXIDATION/CORROSION-RESISTANT COMPOSITE MATERIALS AND INTERFACES**
$127,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: D. P. Stinton, (423) 574-4556

Fiber-reinforced SiC-matrix composites have been observed to fail in fossil energy applications for two reasons. First, the mechanical properties of composites deteriorate under stressed oxidation because oxidants such as steam penetrate cracks formed in the SiC matrix and react with the carbon or boron nitride interface. The mechanical properties of composites may degrade because of corrosion due to sodium species typically present in fossil systems. Therefore, the purposes of this task are to first, develop fiber-matrix interfaces that are resistant to oxidation and yet optimize the mechanical behavior of composites, and second, to develop protective overcoats or oxide matrices that are resistant to oxidation and corrosion.

Keywords: Composites, Ceramics, Fiber-Reinforced, Interfaces

520. **OPTIMIZATION OF THE CHEMICAL VAPOR INFILTRATION TECHNIQUE FOR CERAMIC COMPOSITES**
$85,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
University of Tennessee Contact: Peter Liaw, (423) 974-6356

This project is focused on an optimization of the forced chemical vapor infiltration technique for fabrication of ceramic matrix composites (CMCs) using process models. In particular, a process model developed at the Georgia Tech Research Institute shall be thoroughly investigated. Experimental verification of the process model shall be conducted in light of microstructural characterization using both destructive and nondestructive evaluation techniques. An optimized process for manufacturing CMCs shall be demonstrated. Moreover, mechanistic understanding regarding the effects of processing parameters on microstructural features, and fatigue and fracture behavior of CMCs shall be provided.

Keywords: Composites, Fiber-Reinforced, Ceramics

521. **TRANSPORT PROPERTIES OF CERAMIC COMPOSITES**
$148,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Georgia Institute of Technology Contact: T. L. Starr, (404) 853-0579

The purpose of this research effort is to conduct a theoretical and experimental program to identify new compositions and processing methods to improve the physical and mechanical properties of selected fiber-reinforced ceramics. The ceramic matrix material is amorphous fused silica or modified silica glass, and the focus is the development of fiber-reinforced silica. Parameters studied include: (1) differences in elastic modulus between matrix and fiber, (2) differences in thermal expansion, (3) nature of interfacial bond, (4) densification of matrix, (5) nature of fiber fracture/pull-out, (6) fiber diameter and fiber length-to-diameter ratio, (7) fiber loading, and (8) fiber dispersion and orientation. A model will be developed based on the information generated in the experimental phase of the program.

Keywords: Ceramics, Composites, Fiber-Reinforced

522. **MODELING OF FIBROUS PREFORMS FOR CVD INFILTRATION**
$50,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Georgia Institute of Technology Contact: T. L. Starr, (404) 853-0579

The purpose of this project is to conduct a theoretical and experimental program to develop an analytical model for the fabrication and infiltration of fibrous preforms. The analytical model will: (1) predict preform structure (density, porosity, fiber orientation, etc.) based on fabrication technique and fundamental fiber parameters (diameter, aspect ratio, etc.), and (2) predict permeation and heat conduction through the preform structure and, thus, predict the CVD infiltration performance.

Keywords: Ceramics, Composites, Modeling

523. **CORROSION PROTECTION OF SiC-BASED CERAMICS WITH CVD MULLITE COATINGS**
$50,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Boston University Contact: Vinod Sarin, (617) 353-6451

This project involves the growth of dense mullite coatings on SiC-based substrates by chemical vapor deposition. SiC and SiC-based composites have been identified as the leading candidate materials for stringent elevated temperature applications. At moderate temperatures and pressures, the formation of a thin self-healing layer of SiO_2 is effective in preventing catastrophic oxidation by minimizing the diffusion of O_2 to the substrate. The presence of impurities can increase the rate of passive oxidation by modifying the transport rate of oxygen through the protective scale, can cause active oxidation via formation of SiO which accelerates the degradation process, or can produce compositions such as Na_2SO_3 which chemically attack the ceramic via rapid corrosion. There is therefore a critical need to develop adherent oxidation/corrosion-resistant, and thermal-shock-resistant coatings that can withstand such harsh environments. Mullite has been identified as an excellent candidate material due to its desirable properties of toughness, corrosion resistance, and a good coefficient of thermal expansion match with SiC.

Keywords: Ceramics, Coatings

524. **FEASIBILITY OF SYNTHESIZING OXIDE FILMS ON CERAMIC AND METAL SUBSTRATES**
$100,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Lawrence Berkeley Laboratory Contact: Ian Brown, (510) 486-4174

The objective of this project is the study of the feasibility of synthesizing metal oxide ceramic films on ceramic and metal substrates. This feasibility will be demonstrated by use of plasma-based deposition and ion mixing techniques. The films shall be characterized for properties such as composition, structure, hardness, high temperature oxidation resistance, adhesion to the substrate, and stability to high temperature cycling. The value of intermediate transition or buffer layers, composed of materials with suitably matched thermal expansion characteristics and atomically graded interfaces, as a technique for improving the high temperature survivability of the films, shall be explored. Samples shall be formed on substrates of various shapes and sizes, including perhaps on the inside and outside of pipes, as well as on small flat coupons. The issue of deposition onto and atomic mixing into substrates which are insulating shall be addressed experimentally. The work is divided into two parts: (1) Al_2O_3 films on alumina-forming alloy substrates, and (2) oxides on SiC.

Keywords: Ceramics, Films, Oxides

525. **SCREENING ANALYSIS OF CERAMIC HOT-GAS FILTER MATERIALS**
$0 (PYF)*
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Pennsylvania State University Contact: R. E. Tressler, (814) 865-7961

This project will include a screening analysis of candidate ceramic hot-gas filter materials. A flow-through screening test will be developed to test ceramic hot-gas filter elements in simulated coal combustion environments.

Keywords: Ceramics, Corrosion, Coatings

526. **ENVIRONMENTAL EFFECTS ON CERAMICS**
$100,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contacts: P. F. Tortorelli, (423) 574-5119

The purpose of this work is to support the development of advanced ceramics and ceramic composites for applications in fossil environments by examining critical issues related to high-temperature corrosion resistance. More specifically, the overall objective of this task is to examine the chemical compatibility and reliability of potentially corrosion-resistant ceramics being developed as protective overcoats and/or structural materials as parts of other work elements funded by the AR&TD Program.

Keywords: Coatings, Corrosion

*PYF denotes that funding for this activity, active in FY 1995, was provided from prior year funds.

527. **CERAMIC COATING EVALUATION**
$100,000
DOE Contacts: J. P. Carr, (301) 903-6519 and
E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contacts:
P. F. Tortorelli, (423) 574-5119

The purpose of this work is to generate the information needed for the development of improved (slow growing, adherent, sound) protective oxide coatings and scales. The specific objectives are to systematically investigate the relationships among substrate composition and surface oxide structure, adherence, soundness, and micromechanical properties, (2) use such information to predict scale and coating failures, and (3) identify and evaluate compositions and synthesis routes for producing materials with damage-tolerant scales and coatings.

Keywords: Coatings, Corrosion

528. **METAL DUSTING STUDY**
$25,000
DOE Contacts: J. P. Carr, (301) 903-6519 and
E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contacts:
P. F. Tortorelli, (423) 574-5119

The objective of this task is to establish the potential risk of operating problems due to carbon deposition and metal dusting in advanced coal gasification processes and to identify methods for avoiding carbon deposition. The work involves a literature search, compilation of a bibliography of relevant articles, and a summary of the current state of knowledge.

Keywords: Coatings, Corrosion

529. **LOW-TEMPERATURE FABRICATION OF TRANSPARENT SILICON NITRIDE**
$100,000
DOE Contacts: J. P. Carr, (301) 903-6519 and
E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole,
(423) 574-4824
National Institute of Standards and Technology
Contact: S. G. Malghan, (301) 975-6101

The objective of this research is the production of dense, hard, transparent ceramics from nanosize particles without the use of sintering aids. The work will concentrate on the fabrication of samples of transparent silicon nitride using the cryogenic compaction technique. TEM, SEM, X-ray diffraction, and laser light scattering will be used to characterize the microstructure. Hardness at various temperatures will be measured to assess the creep resistance of the material. Fracture toughness and bending strength will also be measured.

Keywords: Ceramics, Mechanical Properties

530. **MICROWAVE-ASSISTED CHEMICAL VAPOR INFILTRATION**
$25,000
DOE Contacts: J. P. Carr, (301) 903-6519 and
E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact:
M. A. Janney, (423) 574-4281

The purpose of this research effort is to explore the feasibility of using microwave heating to enhance the chemical vapor infiltration (CVI) process developed under the Fossil Energy Materials Program (FEMP) sponsorship. The goal is to achieve faster deposition rates, greater control over deposition conditions and resulting microstructures, and perhaps lower temperature infiltration.

Keywords: Ceramics, Microwave Processing

531. **DEVELOPMENT OF MICROWAVE-HEATED DIESEL PARTICULATE FILTERS**
$75,000
DOE Contacts: J. P. Carr, (301) 903-6519 and
E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact:
M. A. Janney, (423) 574-4281

The purpose of this research, which derives from our work on ceramic filters for coal systems, is to help develop microwave-eated diesel engine particulate filter/burner devices. The goal is to develop materials that will perform both as filter and heater in such a device. A Cooperative Research and Development Agreement (CRADA) between Lockheed Martin Energy Systems and the Cummins Engine Company is in place that supports this work, CRADA No. ORNL93-0172. We propose to develop a ceramic composite structure of SiC-coated ceramic fiber that can be used as a diesel engine particulate filter. For commercial usage a particulate filter must: (1) filter carbon particles from high temperature diesel exhaust gas at an acceptable (low) backpressure; (2) survive thousands of thermal transients caused by regeneration (cleaning) of the filter by oxidizing the collected carbon; (3) be durable and reliable over the life of the filter, which is in excess of 300,000 miles (10,000 hours of operation); and (4) provide a low overall operating cost which is competitive with other filtering techniques.

Keywords: Ceramics, Microwave Processing

532. **CARBON FIBER COMPOSITE MOLECULAR SIEVES**
$275,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: T. D. Burchell, (423) 576-8595

Hydrogen recovery technologies are required to allow the upgrading of heavy hydrocarbons to transport fuels, thus reducing the amount of carbon rejected during the conversion of fossil resources into hydrocarbon products. The purpose of this work is to develop carbon molecular sieves (CMS) starting with porous carbon fiber composites (CFC) manufactured from petroleum pitch derived carbon fibers. The carbon fiber composite molecular sieves (CFCMS) will be utilized in pressure swing adsorption units for the efficient recovery of hydrogen from synthesis gas, refinery purge gases, and for other gas separation operations associated with hydrogen recovery.

Keywords: Carbon Fibers, Sieves, Composites

533. **CARBON MATERIALS EQUIPMENT**
$15,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: T. D. Burchell, (423) 576-8595

This task provides funds for the procurement of major equipment items necessary for AR&TD Materials Program activities.

Keywords: Equipment

534. **ACTIVATION OF CARBON FIBER COMPOSITE MOLECULAR SIEVES**
$75,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
University of Kentucky Contact: Frank Derbyshire, (606) 257-0305

A novel monolithic adsorbent carbon, manufactured from carbon fibers, has been invented jointly by researchers at Oak Ridge National Laboratory (ORNL) and the University of Kentucky Center for Applied Energy Research. The novel material, referred to as a carbon-fiber composite molecular sieve (CFCMS) is fabricated at ORNL in the Carbon Materials Technology Group. The purpose of this activity is to activate samples of the CFCMS and to perform subsequent analyses of the surface area, pore width distributions, and micropore volume. Activities are directed toward an understanding of the relationships between the activation process and the micro- or mesopore structure that develops.

Keywords: Carbon Fibers, Sieves, Composites

535. **CHARACTERIZATION OF COAL AND COAL EXTRACTS**
$20,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
University of Tennessee Contact: E. L. Fuller, (423) 974-6356

The objective of this work is to characterize coal and coal extracts and to assist Oak Ridge National Laboratory in the research activities connected with the Cooperative Research Partnership on Carbon Products and the Non Fuel Uses of Coal. Work involves the characterization of coal and coal extracts obtained form West Virginia University. Activation and reactivity studies of carbon materials, including carbon fiber composite molecular sieves, shall be performed. Analysis of the pore structures of activated carbons, including carbon fiber composite molecular sieves, shall be performed.

Keywords: Carbon Fibers, Sieves, Composites

536. **PRODUCTION OF ALUMINUM REDUCTION ELECTRODES FROM SOLVENT-EXTRACTED COAL-DERIVED CARBON FEEDSTOCKS**
$0 (PYF)*
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Alcoa Aluminum Company Contact: Dave Belitskus, (412) 337-4812

This research is directed toward the objective of producing aluminum reduction electrodes from solvent-extracted coal-derived carbon feedstocks obtained from West Virginia University (WVU) and Koppers Industries, Inc.

Keywords: Carbon, Feedstocks, Coal-Derived

*PYF denotes that funding for this activity, active in FY 1995, was provided from prior year funds.

537. **EXPLORATION OF COAL-BASED PITCH PRECURSORS FOR ULTRA-HIGH THERMAL CONDUCTIVITY GRAPHITE FIBERS**
$0 (PYF)*
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Amoco Performance Products, Inc. Contact: G. V. Deshpande

The preparation of high-performance carbon (graphite) fibers requires a mesophase pitch precursor. Traditionally, in the USA, this has been derived from a petroleum precursor. Overseas suppliers have, however, developed high-performance fibers from coal derived precursors. Amoco Performance Products' goal is to explore coal-based pitch precursors' utility for use in ultra-high thermal conductivity graphite fibers.

Keywords: Carbon, Fibers, Graphite, Precursors

538. **DEVELOPMENT OF CARBON-CARBON COMPOSITES FROM SOLVENT-EXTRACTED PITCH**
$0 (PYF)*
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Fiber Materials, Inc. Contact: Cliff Baker, (207) 282-5911

The manufacture of carbon-carbon composites for use in the aerospace industry has been heavily reliant on petroleum and coal tar pitches as matrix precursors. It is of great importance to strategic materials production for the Department of Defense that a stable, long-lived source of pitch be developed. Consequently, Fiber Materials, Inc. will work with staff members at the Oak Ridge National Laboratory and at West Virginia University to develop carbon-carbon composite materials from pitches derived from coal via a solvent extraction process. The objectives of this project shall be twofold. First, FMI shall use solvent extracted pitch to develop carbon-carbon composites with similar or improved properties over those currently manufactured from Allied 15V coal tar or Ashland A-240 petroleum pitches. Second, FMI shall develop improved, lower-cost composites from improved solvent extracted pitches supplied by WVU.

Keywords: Carbon, Composites, Pitch

539. **CONVERSION OF PITCHES AND COKES FROM SOLVENT-EXTRACTED MATERIALS**
$0 (PYF)*
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Koppers Industries, Inc. Contact: R. McHenry, (412) 826-3989

The closure of by-product coke ovens has caused the domestic production of coal tar pitch to decline at 3 percent to 4 percent per annum during the mid-1990s. This reduction has directly affected Koppers' capability to produce required quantities of quality binder and impregnating pitches used in the aluminum and commercial carbon and graphite industries. Moreover, the other major constituent of carbon anodes and graphites is a coke, usually produced from petroleum pitch precursors, 50 percent of which are imported. The objectives of this research are to develop dependable domestic coal-based raw materials for the production of: binder pitches for aluminum cell anodes and commercial carbon and graphite products; impregnating pitches for commercial carbon and graphite products and specialty materials; oils for wood treatment and carbon black production; chemicals for phthalic anhydride and other products; and metallurgical and foundry grade cokes.

Keywords: Coke, Pitch, Conversion

540. **CARBON FIBER COMPOSITE MOLECULAR SIEVES**
$155,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: T. D. Burchell, (423) 576-8595

Hydrogen and Methane gas recovery technologies are required to: (1) allow the upgrading of heavy hydrocarbons to transport fuels, thus reducing the amount of carbon rejected during crude oil refining and (2) to improve the yield and process economics of natural gas wells. The purpose of this work is to develop carbon fiber composite molecular sieves (CFCMS) from porous carbon fiber composites manufactured from solvent extracted coal tar pitch derived carbon fibers. The work will be performed in collaboration with other members of the Cooperative

*PYF denotes that funding for this activity, active in FY 1995, was provided from prior year funds.

Research Partnership on Carbon Products and the Non Fuel Uses of Coal.

Keywords: Consortium, Carbon Products

541. **DEVELOPMENT OF PRECURSORS FOR PRODUCTION OF GRAPHITES AND CARBON PRODUCTS**
$0 (PYF)*
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
UCAR Carbon Company Contact: Irv Lewis, (216) 676-2203

The manufacture of graphite utilizes cokes and pitches derived from petroleum refining by-products and by-product coke ovens. These include isotropic and anisotropic cokes, binder, and impregnant pitches. Assuring feedstock quality is of great importance to the graphite industry. Therefore, a stable long-lived source of feedstock pitch (and hence coke) would be of considerable benefit to the industry. Consequently, UCAR Carbon Company Inc. shall work with staff members at the Oak Ridge National Laboratory and at the West Virginia University to develop suitable precursor pitches, binders, impregnants, and cokes for the production of graphites and other carbon products.

Keywords: Carbon Products, Precursors, Graphites

542. **PRODUCTION OF YARN FROM VLS WHISKERS**
$100,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824

In order to exploit the superior thermomechanical properties of fibrils produced by the Vapor-Liquid-Solid (VLS) Process, the feasibility of scaled-up production of the SiC fibril will be demonstrated in this activity. Through time-series study and computer simulation, the parameters affecting the growth process and properties of the fibrils will be examined.

Keywords: Whiskers, Fibers, Ceramic

543. **RADIO-WAVE NANO-PHASE SILICON CARBIDE AND SILICON NITRIDE PROCESSES**
$100,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Sandia National Laboratories Contact: R. J. Buss, (505) 844-3504

This program examines the use of radio-frequency plasma discharges as a synthetic route to nanometer-size silicon carbide and silicon nitride particles.

Keywords: Nanophase, Silicon Nitride, Silicon Carbide

MATERIALS PROPERTIES, BEHAVIOR, CHARACTERIZATION OR TESTING

544. **INVESTIGATION OF THE WELDABILITY OF POLYCRYSTALLINE IRON ALUMINIDES**
$75,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Colorado School of Mines Contact: G. R. Edwards, (303) 273-3773

The purpose of this project is the investigation of the weldability of polycrystalline aluminides. The major thrust of the project is to determine the role of microstructure in the intergranular cracking of aluminides, with special emphasis on weld cracking susceptibility. The weldability of polycrystalline Fe_3Al-X alloys is being evaluated, and the weldability is correlated with composition, phase equilibria, grain size and morphology, domain size, and degree of long-range order.

Keywords: Joining, Welding

545. **AQUEOUS CORROSION OF IRON ALUMINIDES**
$29,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
University of Tennessee Contact: R. A. Buchanan, (423) 974-4858

The objective of this project is to investigate (1) evaluation of the effects of surface conditions on the corrosion and

*PYF denotes that funding for this activity, active in FY 1995, was provided from prior year funds.

embrittlement of Fe-Al alloys, and (2) corrosion fatigue properties of Fe-Al alloys.

Keywords: Alloys, Aluminides, Corrosion, Stress

546. **EVALUATION OF THE INTRINSIC AND EXTRINSIC FRACTURE BEHAVIOR OF IRON ALUMINIDES**
$68,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
West Virginia University Contact: B. R. Cooper, (304) 293-3423

The purpose of this activity is the evaluation of the intrinsic and extrinsic fracture behavior of iron aluminides and the study of atomistic simulations of defect concentrations, dislocation mobility, and solute effects in Fe_3Al. The work also involves an experimental study of environmentally-assisted crack growth of Fe_3Al at room and at elevated temperatures. The combined modeling and experimental activities are expected to elucidate the mechanisms controlling deformation and fracture in Fe_3Al in various environments.

Keywords: Alloys, Aluminides, Fracture

547. **INVESTIGATION OF IRON ALUMINIDE WELD OVERLAYS**
$56,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Lehigh University Contact: J. N. DuPont, (610) 758-3942

The objective of this activity is the investigation of iron aluminide weld overlays. Specific tasks include: (1) filler wire development, (2) weldability, (3) oxidation and sulfidation studies, (4) erosion studies, (5) erosion-corrosion studies, and (6) field exposures.

Keywords: Alloys, Aluminides, Overlay, Welding, Joining

548. **FIRESIDE CORROSION TESTS OF CANDIDATE ADVANCED AUSTENITIC ALLOYS, COATINGS, AND CLADDINGS**
$80,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Foster Wheeler Development Corporation Contact: J. L. Blough, (201) 535-2355

The purpose of this project is to provide comprehensive corrosion data for selected advanced austenitic tube alloys in simulated coal ash environments. ORNL-modified alloys and standard comparison alloys have been examined. The variables affecting coal ash corrosion and the mechanisms governing oxide breakdown and corrosion penetration are being evaluated. Corrosion rates of the test alloys are determined as functions of temperature, ash composition, gas composition, and time.

Keywords: Austenitics, Alloys, Corrosion

549. **JOINING TECHNIQUES FOR ADVANCED AUSTENITIC ALLOYS**
$50,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
University of Tennessee Contact: C. D. Lundin, (423) 974-5310

Weldability is an important consideration in the selection of a suitable alloy for the fabrication of boiler components such as superheaters and reheaters. It is often a challenge to select joining materials and establish procedures that will allow advanced materials to function at their full potential. The purpose of this research is to examine important aspects of newly developed austenitic tubing alloys intended for service in the temperature range 550 to 700°C.

Keywords: Alloys, Austenitics, Joining, Welding

550. **FATIGUE AND FRACTURE BEHAVIOR OF Cr-Nb ALLOYS**
$20,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
University of Tennessee Contact: Peter Liaw, (423) 974-6356

The objective of this research shall be to characterize the fatigue and fracture behavior of Cr_2Nb-based alloys and other intermetallic materials at ambient and elevated temperatures in controlled environments. These studies are expected to lead to mechanistic understanding of the fatigue and fracture behavior of these alloys. Fatigue tests shall be conducted for the purpose of evaluating crack initiation and fatigue life of Cr_2Nb-based alloys as well as other intermetallic alloys. The fatigue properties shall be evaluated as functions of test environment, cyclic frequency and test temperature. Additional tensile tests will be required to characterize the fracture behavior of these structural alloys. Mechanical tests shall be performed to determine the fatigue and fracture behavior of Cr_2Nb-based alloys. The microstructure of the alloys shall be characterized and correlated with the mechanical properties.

Keywords: Fracture, Fatigue, Alloys

551. **CORROSION AND MECHANICAL PROPERTIES OF ALLOYS IN FBC AND MIXED-GAS ENVIRONMENTS**
$310,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Argonne National Laboratory Contact: K. Natesan, (708) 252-5103

The purposes of this task are to: (1) evaluate the corrosion mechanisms for chromia- and alumina-forming alloys in mixed-gas environments, (2) develop an understanding of the role of several microalloy constituents in the oxidation/sulfidation process, (3) evaluate transport kinetics in oxide scales as functions of temperature and time, (4) characterize surface scales that are resistant to sulfidation attack, and (5) evaluate the role of deposits in corrosion processes.

Keywords: Corrosion, Gasification, Creep Rupture, Fluidized-Bed Combustion

552. **MECHANICALLY RELIABLE COATINGS AND SCALES FOR HIGH-TEMPERATURE CORROSION RESISTANCE**
$50,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: N. C. Cole, (423) 574-4824
Argonne National Laboratory Contact: K. Natesan, (708) 252-5103

This project involves the development of mechanically reliable coatings and scales for high-temperature corrosion resistance. ANL shall systematically generate the knowledge required to establish a scientific basis for design and synthesis of improved (slow growing, adherent, sound) protective oxide coatings and scales on high temperature materials, without compromising the requisite bulk material properties. In addition, ANL shall provide information on the performance of advanced candidate materials from the standpoint of corrosion resistance and residual mechanical properties, after exposure in simulated combustion environments typical of indirectly-fired gas turbines. The work shall emphasize corrosion evaluation of materials in air, salt, and coal/ash environments at temperatures between 1000° and 1400°C, and measurement of residual toughness properties of the materials after corrosion.

Keywords: Corrosion, Coatings, Scales

553. **ENVIRONMENTAL EFFECTS ON IRON ALUMINIDES**
$145,000
DOE Contacts: J. P. Carr, (301) 903-6519 and E. E. Hoffman, (423) 576-0735
Oak Ridge National Laboratory Contact: P. F. Tortorelli, (423) 574-5119

The purpose of this task is to evaluate the high-temperature corrosion behavior of iron-aluminum alloys as part of the effort to develop highly corrosion-resistant iron-aluminide alloys and coatings for fossil energy applications. A primary objective is to investigate the resistance of the alloys to mixed-oxidant (oxygen-sulfur-chlorine-carbon) environments that arise in the combustion or gasification of coal. This includes the determination of the influence of sulfur and other reactive gaseous species on corrosion kinetics and oxide microstructures and the effects of alloying additions and oxide dispersoids on sulfidation and oxidation resistance.

Keywords: Corrosion, Aluminides, Mixed-Gas, Scales